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Capability, Knowledge, and Innovation: Strategies for Capability Development and Performance *

by

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CAPABILITY, KNOWLEDGE, AND INNOVATION:

STRATEGIES FOR CAPABILITY DEVELOPMENT AND PERFORMANCE

Abstract

This paper analyzes the strategies that companies use to develop the capability to mobilize knowledge and create new knowledge for innovation using both inductive and large sample studies. The results show that companies follow one of three strategies: "organization", "project team", and "mixed". Though more companies follow the "project team" strategy, the "mixed" strategy is associated with higher performance in terms of the capability developed and financial performance, followed by the "project team" and the "organization" strategies. [76]

Key words: Capability, Knowledge Mobilization, Knowledge Creation, Innovation, Performance

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INTRODUCTION

The capability to mobilize knowledge and create new knowledge for innovation is critical for competitive advantage, but we still do not know how to develop it. This capability has been discussed as "integrative capability" (Lawrence and Lorsch, 1967), "core competence" (Prahalad and Hamel, 1990), "combinative capability" (Kogut and Zander, 1992), and "dynamic capability" (Teece, Pisano, and Shuen, 1997), and these authors considered it as key for competition. However, despite the extensive debate about the value of firms' capability to mobilize knowledge and create new knowledge for innovation, there is still limited understanding of "how" companies develop it. As Foss, Knudsen, and Montgomery (1995) indicate: "The question of intentionality becomes particularly salient when considering how a firm sets out to build a given set of capabilities. Because resources that support a competitive advantage are by definition inimitable, and unidentifiability is a sufficient condition for inimitability, it is difficult to say how one should invest to build a competitive advantage. On the other hand, the view that one cannot make such investments purposively is not satisfactory either. Is there a way out of this conundrum?" (p. 13).

Therefore, the overarching research question of this paper is "How do companies develop the capability to mobilize knowledge and create new knowledge for innovation?" In answering this question, I link and integrate the theoretical approaches of the resource-based theory of the firm (Penrose, 1959; Wernerfelt, 1984; Barney, 1991), innovation literature based in organization theory (Lawrence and Lorsch, 1967; Nohria and Ghoshal, 1997) and innovation literature based in organizational behavior (Ancona and Caldwell, 1992a, 1992b; Clark and Wheelwright, 1992).

I use both inductive and large sample studies to answer the research question. The analysis of multiple comparative case studies of 24 innovation teams in three companies enables the development of an empirically grounded theory and propositions on how companies develop the capability to mobilize knowledge and create new knowledge for innovation. Then, the large sample study of 182 cross-functional innovation teams in 38 companies serves to test the propositions developed in the inductive study and achieve generalizeability. It also enables us to answer the related question, What are the key practices and strategies for developing the capability to mobilize knowledge and create new knowledge for innovation and how they relate to performance?

The analyses reveal that companies use one of three strategies –"organization", "project team" or "mixed"– to develop the capability to mobilize knowledge and create new knowledge for innovation. Companies that follow the "organization" strategy develop their employees such that the organization-level processes that support innovation are generated regardless of when they are used in the process of innovation. Companies that follow the "project team" strategy develop their employees only as needed in the process of innovation. Companies that use the "mixed" strategy develop their personnel at both levels. The "mixed" strategy is associated with higher performance in terms of the capability developed and financial performance, followed by the "project team" and the "organization" strategy.

The rest of the paper is organized as follows. Section 2 presents the theoretical background. Section 3 provides the research design for the inductive study. Section 4 presents results of the inductive study and the proposition developed. Section 5 introduces the research design for the large sample analysis. Section 6 provides the results of the empirical test of the proposition. Section 7 concludes.

THEORETICAL BACKGROUND: CAPABILITY TO MOBILIZE KNOWLEDGE AND CREATE NEW KNOWLEDGE FOR INNOVATION

The resource-based theory of the firm can be expanded by linking it to both the innovation literature based in organization theory and the innovation literature based in organizational behavior to provide a better understanding on the process of developing the capability to mobilize knowledge and create new knowledge for innovation.

Capability to mobilize knowledge and create new knowledge for innovation in the resource-based view

Within the resource-based view, there are two camps that study this capability: one emphasizes knowledge mobilization and the other knowledge creation. Researchers who emphasize the mobilization process tend to assume creation occurs and only discuss the factors that facilitate knowledge mobilization, particularly cooperation and communication patterns (Prahalad and Hamel, 1990; Kogut and Zander, 1992). However, they do not explain specifically how these factors are developed. Prahalad and Hamel (1990) suggest that firms that have core competencies manage their employees such that there is a shared sense of cooperation in achieving organizational goals and communication patterns that transcend functional and business boundaries. They view firms that have core competencies as firms that induce their employees to share or mobilize knowledge and expertise across boundaries to generate innovations. Firms that lack core competencies view each part of the organization as rivals, and therefore, limits knowledge mobilization by hiding critical knowledge from each other rather

than sharing it to create new resources. Kogut and Zander (1992) suggest that the "organizing principles" facilitate the development of this capability by facilitating communication and cooperation. However, it is unclear what these organizing principles are in developing this capability. Moreover, Nelson and Winter (1982) and Teece et al. (1997) suggest that cross-functional communication routines are important for having this capability. However, we do not know how these supporting routines are developed.

Researchers who emphasize the creation process (Nonaka and Takeuchi, 1995; Nonaka, 1994; Leonard-Barton, 1995) view individuals as boundedly rational, and therefore, even if the motivation problem for knowledge mobilization is solved, knowledge that is being mobilized does not lead to new knowledge creation. Since individuals are boundedly rational, they face the problems of absorbing and converting knowledge that is being shared and convert it into organizational knowledge because of knowledge specialization in organization (e.g., Nonaka and Takeuchi, 1995; Nonaka, 1994; Leonard-Barton, 1995). This limitation is solved by having individuals with the absorptive capacity (Cohen and Levinthal, 1990) for different types of knowledge that is being shared. Therefore, in developing the capability to mobilize knowledge and create new knowledge for innovation, for mobilization, organization design or management practices that motivate knowledge sharing are critical (Lawrence and Lorsch, 1967; Galbraith, 1977; Nohria and Ghoshal, 1997), and the conversion process requires overlapping knowledge (e.g., Nonaka and Takeuchi, 1995; Nonaka, 1994; Leonard-Barton, 1995).

Innovation in organization theory

The innovation literature based in organizational theory suggest that knowledge mobilization is facilitated by a set of integrative mechanisms, which are related to how

employees are managed (Lawrence and Lorsch, 1967; Miles and Snow, 1978; Beer, Eisenstat, and Spector, 1990). These practices are designed to facilitate cross-functional communication and the building of shared sense of commitment and cooperation in achieving organizational goals. The integrative mechanisms include the use of incentive practices whereby individuals are designated as integrators and are rewarded for this role (Lawrence and Lorsch, 1967). Another facilitating factor is job design that is based on team concepts e.g. taskforces (Galbraith, 1977; Ghoshal et al., 1994) whereby individuals are assigned to work on projects rather than individually designed tasks. Moreover, individuals are rewarded for the behavior of knowledge sharing (Aoki, 1988), or they are socialized across different functions (Nohria and Ghoshal, 1997) such that they build social ties across functions that facilitates cross-functional communication frequency. The initial socialization of new employees also facilitate the development of shared sense of commitment and vision in achieving organizational goals. In addition, recent studies of organizations that are effective in motivating knowledge sharing also select employees with characteristics that are conducive to cooperation and and knowledge sharing (Ichniowski, Prennushi, and Shaw, 1997). Therefore, for knowledge mobilization, employees are either incentivized to share their individual knowledge through communication or they can be managed such that they build social ties with other individuals in different functions.

Innovation in organizational behavior

Moreover, another stream of literature on innovation that focuses on the project team-level of analysis, which specifically deals with when organizations organized their employees into project teams for innovation, similar to the organizational capability and organization-level innovation literatures, suggests that team-level processes such as communication frequency and

the shared sense of commitment and cooperation among team members are critical for knowledge mobilization. These team-level processes are facilitated by a set of project team management practices such as team development (Roth and Kleiner, 1996) and reward for team performance (Ancona and Caldwell, 1999). Team development is a process by which team members are taught to communicate with members from different functions, trust building, and setting the agenda for meetings to share knowledge. Reward for team performance also encourages cooperation and communication (Lawler, 1994; Wageman, 1995; Wageman and Baker, 1997).

Other literature on innovation explains the practices that facilitate the process of creating new knowledge for innovation. This stream of literature suggests that the processes of knowledge creation require overlapping knowledge among individuals involved in the creation process (Iansiti, 1998; Madhaven and Grover, 1998). Therefore, the capability to mobilize knowledge and create new knowledge requires the development of personnel such that they have overlapping knowledge in different disciplines. Moreover, since effective resources creation, i.e., product innovation also requires deep disciplinary expertise and knowledge and some degree of diversity among them, only some employees acquire overlapping disciplinary knowledge. Since employees in organization have different knowledge sets, when organized into project teams for mobilizing and creating new knowledge, membership selection, based in part, on overlapping knowledge is important (Nonaka and Takeuchi, 1995: 77). Therefore, the capability to mobilize knowledge and create new knowledge for innovation is developed by using a set of project team-level human resource management practices when organized to mobilize knowledge and create new knowledge for innovation.

The limitations in the resource-based view and the separation of theories on innovation in organization theory and organizational behavior lead to the undertaking of an inductive study to analyze how the capability to mobilize knowledge and create new knowledge for innovation is developed. This is important for two reasons. First, organizational capability and innovation literatures based in organization theory and organizational behavior are about the processes by which companies mobilize knowledge to create new knowledge for developing new resources and the factors that support them. Second, though the level of analysis of the organizational capability approach is the organization, its unit of analysis is the team. The main driver behind the capability to mobilize knowledge and create new knowledge for innovation is how well small groups of carriers of core competence or project teams can effectively mobilize knowledge and convert their individual knowledge into organizational knowledge in the form of product and/or process innovation (Prahalad and Hamel, 1990; Kogut and Zander, 1992; Teece et al., 1997; Nonaka and Takeuchi, 1995).

RESEARCH DESIGN FOR THE INDUCTIVE STUDY

The inductive study consists of the analysis of the factors and practices used to develop the capability to mobilize knowledge and create new knowledge for innovation in 24 cross-functional innovation teams of three companies. The companies were selected on the basis of achieving maximum divergence in the practices and factors, the independent variables, rather than on the capability to mobilize knowledge and create new knowledge for innovation, the dependent variable. For each company, eight randomly selected cross-functional innovation project teams were selected for analysis.

Data were collected from three manufacturing plants, one located in the Northeastern United States (Company Alpha), one in the Midwestern United States (Company Sigma), and another in a suburb of Tokyo, Japan (Company Beta). Each plant houses more than 500 employees, with design, manufacturing, production, and sales/customer services in one location. These plants also have project teams working on process and product innovations involving each of these functions.

Data were collected following the case study data collection protocol (Yin, 1984). I used five different collection methods: trade journals, company archival records, interviews, direct observation, and a short questionnaire. Before visiting the companies for the purpose of making observations and conducting interviews, I analyzed each company using annual reports, company-supplied archival data, and secondary sources of information such as trade journals.

Constructs and Variables

This study focuses on variables related to five main constructs: outcome of the capability to mobilize knowledge and create new knowledge for innovation, project team-level processes, project team-level human resource management practices, organization-level processes, and organization-level human resource management practices. The selected variables are analyzed either because previous literature indicates they are relevant for developing the capability to mobilize knowledge and create new knowledge for innovation, or because interviews and direct observation indicates they influence the development of this capability.

Capability to mobilize knowledge and create new knowledge for innovation. The construct capability to mobilize knowledge and create new knowledge for innovation is represented by its outcome, in this case, the number of innovations each organization generated

through its project teams that were selected for the study. For Alpha, six out of the eight teams came up with an innovation; therefore, as an organization, it has six innovations. For Beta, all teams came up with an innovation; therefore, it has eight innovations. Sigma has only five innovations, since only five out of the eight teams created new knowledge for innovation. Though this measure of capability is consistent with the literature (Prahalad and Hamel, 1990; Kogut and Zander, 1992; Teece et al., 1997), other measures are also important, particularly efficiency in terms of resources used in achieving the innovation (Clark and Fujimoto, 1991; Ancona and Caldwell, 1992), speed-to-market of the innovation, customer satisfaction with the innovation (Clark and Wheelwright, 1992), and learning (Prahalad and Hamel, 1990). This limitation is dealt with in the large sample study.

Innovations in this study are related to both products and processes. In Alpha, examples of the innovations generated by the project teams are the redesign of manufacturing processes to improve quality of cameras, which is one of its core products, minimizing down time of assembling cameras, and improving yield in camera production. For Beta, examples of the innovations created by the project teams are the reconfiguration of components of heavyweight construction machines to be launched in the US market, the redesign of plowing machines for the Swedish market, and the redesign of medium-size construction machines with the latest technology licensed from a Swedish company. For Sigma, some of the innovations include the redesign of alternators for the latest model of the sport utility vehicles (SUVs), and redesign of fuel pumps intended for markets with extreme heat (e.g., Saudi Arabia and Southeast Asia).

Project team-level human resource management practices. Project team-level human resource management practices are also divided into two groups, practices that facilitate knowledge mobilization and practices that facilitate knowledge creation. The facilitators of

knowledge mobilization are: (1) Project team development (Thamhain and Wilemon, 1997), which is the training the company provides to teams for performing a particular project. (2) Project team reward (Wageman and Baker, 1997) either for individual performance on team, or team performance, or both, in terms of salary increases, bonus, job assignment, and promotion. The practice that facilitates knowledge creation is project team membership selection (Madhaven and Grover, 1998). The measures for this variable are the specific criteria project teams used in forming their teams.

Organization-level human resource management practices. The organization-level human resource management practices analyzed in this study are based not only on previous research but also on interviews I conducted and on my first-hand observations of the companies. The organization-level human resource management practices are divided into two groups, practices that facilitate knowledge mobilization and practices that facilitate knowledge creation. The facilitators of knowledge mobilization are: (1) Selection (Ichinowski, Prennushi and Shaw, 1997). Measures for this practice are coded from evaluation forms used by recruiters of these companies. (2) For reward, the measures are obtained from the company's performance evaluation forms and discussions with personnel managers about which factors are critical in determining salary increase, promotion, and the award and amount of bonus payment. (3) For the control on individual reward (Katz and Allen, 1985), I conducted interviews concerning the topic of managerial responsibility for control over individual reward (i.e., functional manager, project manager, human resource manager, and peers). For (4) orientation (Nohria and Ghoshal, 1997), I interviewed personnel managers about the introductory steps that new employees take upon their arrival in the organization. (5) For work patterns, I observed and interviewed department managers on how daily tasks were performed in the R&D, sales/marketing, and customer service

functions. The facilitator of knowledge creation is cross-functional development (Nonaka and Takeuchi, 1995; Leonard-Barton, 1995). I asked personnel managers to explain step-by-step the development processes of professional employees, particularly engineers, sales/marketing and production personnel, from the time of entry to retirement (Westney and Sakakibara, 1986).

Method of Analysis

I analyzed the data by first building individual case studies. For each project, I used a combination of the "fishbone method" and flow chart documenting the factors by which knowledge is created and transformed into an innovation. I then compared across cases within and across companies to construct a conceptual framework (Eisenhardt, 1989a). The analysis proceeded as follows: First, I entered all responses into a database indexed by company, project team for each company, interview questions by their number, and then question number from the questionnaires. Second, I constructed a single version of both the organization and team-level interviews for each case by collecting all responses to the same question together as a single response. Using the interviews, answers to the questionnaires, and secondary sources, I wrote a case study for each project, then for each organization.

STRATEGIES FOR DEVELOPING THE CAPABILITY TO MOBILIZE KNOWLEDGE AND CREATE NEW KNOWLEDGE FOR INNOVATION

The inductive study reveals that companies use one of three strategies, which I refer to as the "organization", "project team" or "mixed" to develop the capability to mobilize knowledge and create new knowledge for innovation. The company that follows the "organization" strategy

has higher capability in terms of innovation it generates, followed by the "mixed", and the "project team".

"Organization" strategy. Beta follows the "organization" strategy, which means that it develops its employees such that the organization-level processes that support innovation are generated regardless of when they are used in the process of innovation. It develops the facilitators for knowledge mobilization by developing extensive cross-functional communication patterns or routines and a shared sense of cooperation across functions such that they are built into the organizational context regardless of when they are needed for innovation. Therefore, when organized for innovation, these processes occur automatically on project teams without using project team-level human resource management such as team development, reward for team performance, and team membership selection was based on informal networks and tenure diversity rather than specifically for overlapping knowledge among members. It accomplishes this by selecting new employees based on personality traits conducive to knowledge sharing and cooperation, reward based in part on behavioral factors such as cooperation, dividing up the control over individual's reward system between functional and non-functional managers, the initial socialization that gives a holistic view of the firm, and cross-functional training. Moreover, later on in employees' careers, they are provided with cross-functional development whereby the view of the organization as a system is reinforced and at the same time they acquire knowledge in these different parts.

"Project team" strategy. Sigma follows the "project team" strategy whereby it develops its employees only as needed in the process of mobilizing and creating new knowledge for innovation. At the organization-level it lacks the cross-functional communication routines and the shared sense of cooperation across functions that facilitate knowledge mobilization. In

contrast to Beta, Sigma recruits employees solely based on individual potential performance, reward only based on individual performance, the control over individuals' reward is held by functional managers, and the initial socialization is only within the same function in which they are hired for and expected to remain for the rest of their careers. Moreover, it lacks the facilitator of knowledge creation, overlapping knowledge, because it does not provide cross-functional development. However, when organized for innovation, it tries to develop communication among relevant members from different functions by using external experts on team development to facilitate in trust building so that team members share their knowledge to accomplish the task. Moreover, these experts also develop a shared language and sense of commitment to facilitate communication in order to accomplish the task.

"Mixed" strategy. Alpha uses the "mixed" strategy whereby it develops its employees at both levels. However, unlike Beta, in order to develop cross-functional communication patterns, it divides up the control over individual's reward between functional and the project managers, though functional managers have more control. Similar to Sigma, it selects new employees solely based on their individual potential performance, rewards based only on individual performance, and does not provide any formal orientation. However, it develops its engineers to have overlapping knowledge between manufacturing and R&D, and some off the job training in sales/marketing. However, unlike Beta, this development is less systematic. Not all engineers are given the same training at any given point in time. When organized for innovation it develops its project teams using facilitators who are not team members to facilitate communication in the process of innovation. In addition, it provides reward in terms of favorable job assignment to team members for their team performance. Since overlapping knowledge across functions is developed unsystematically, overlapping knowledge found on

teams are not as automatic as in Beta; and therefore, team members were carefully screened for some overlapping knowledge.

In conclusion, the inductive study identified three strategies for the development of the capability to mobilize knowledge and create new knowledge for innovation. Two of the strategies –organization and project team– were identified in the literature, while the third one –mixed– emerged from the inductive analysis. Hence, I propose that:

Proposition: Companies use one of three strategies –"organization," "project team," or "mixed"– to develop the capability to mobilize knowledge and create new knowledge for innovation. Companies that follow the organization strategy develop their employees such that the organization-level processes that support innovation are generated regardless of when they are used in the process of innovation. Companies that follow the project team strategy develop their personnel only as needed in the process of innovation. Companies that use the mixed strategy develop their employees at both levels.

RESEARCH DESIGN FOR THE LARGE SAMPLE STUDY

After identifying in the inductive analysis three alternative strategies for developing the capability to mobilize knowledge and create new knowledge for innovation –organization, project team, and mixed–, I now conduct a large sample analysis to confirm the existence of the strategies, understand the differences, and test for their performance implications.

Sample

Data were gathered through surveys of 182 cross-functional project teams of 38 large US and Japanese multinational firms in the computer, photo imaging, and automobile industries that

have operations in the United States. The analysis of companies present in different industries supports the generalization of results across industries.

The companies selected were present in the computer, photo imaging, and automobile industries. The industries were selected because they face different innovation cycles –short in the computer industry, medium-sized in the photo imaging industry, and long in the automobile industry– that affect the time pressure on gathering and processing different types of knowledge for innovation (Lawrence and Lorsch, 1967).

The companies were selected based on two factors. First, they were the largest in their respective industries based on revenue as reported in the Hoover's HandBook of World Business (1999). Second, they had customer service centers in the United States and Japan dealing with similar products. This requirement was necessary because this study is part of a larger study that compares sources of this capability of US and Japanese multinational enterprises in both the United States and Japan.

For each company, the largest customer service center in terms of employees located in the United States was selected. These centers were identified using the Directory of Corporate Affiliations (1998). The customer service organization was selected because it is the gatekeeper linking firm's external demands and internal design and manufacturing capabilities (Quinn, 1992). The customer service centers selected had at least three functions represented: sales/marketing, customer service, and engineering linking to the R&D and manufacturing organizations.

In each company, a set of cross-functional project teams was randomly selected. Project teams were selected based on three criteria. First, at least three functions were represented: customer service, engineering (i.e. R&D or manufacturing) and sales/marketing or

manufacturing. Second, the main objective of the team was to transform specific external customer feedback obtained from the firm's worldwide operations about their products into an innovation.

Data Collection

There were three steps to the data collection process. First, in depth field interviews, observations and phone interviews were conducted to ensure a deep understanding of the phenomenon. Second, a pilot study was conducted to test the variables and measures and survey instruments. Finally, the surveys were conducted.

In order to avoid single respondent bias and separate out levels of analysis, I collected the data from three different sources using three separate surveys (Rousseau, 1985; Klein, Tosi, Cannella, and Albert, 1999). Data on the organization-level management practices and processes were collected from a personnel manager, because a personnel function is a boundary function and therefore this manager has the best knowledge about the interaction between and among different functions and can speak about it more objectively.

The data for the team-level variables were collected from the project team leaders and the project managers. For each company the project manager was asked to provide a list of projects and the team leaders that supervised them. Based on this list, randomly selected team leaders were asked to take a survey on team management practices, and performance. However, in order to minimize team response bias, project managers were also asked to evaluate the outcomes of these projects using the same metrics used in the questionnaire for the team leaders (Ancona and Caldwell, 1992a). The empirical analysis presented in this study is based on the project managers' rating since project managers are probably less bias about team performance than the

team leaders, as they were not directly involved in the project. However, team leaders' ratings were also analyzed for comparison. The results were consistent with the results based on the project managers' rating.

Measures

Capability to mobilize knowledge and create new knowledge for innovation and financial performance. The construct capability to mobilize knowledge and create new knowledge is represented by its outcome, innovation, since this intangible capability is not measurable directly but only through its effects (Godfrey and Hill, 1995). Innovation (O-PRODNOV) follows the definition of Van de Ven (1986), and Nohria and Gulati (1995). Innovation is measured by the firm's level of success in incorporating external customer feedback from its worldwide operations into new product development and product modification as well as by the number of products developed within the last five years ($\alpha = 0.84$). Another organization-level variable is the level of customer satisfaction with the innovations (O-CUSTSAT). This variable is measured by ratings published by JD Power & Associates for the automobile industries, PC World Magazine for the computer industry, and an external marketing research company for the photo imaging industry ($\alpha = 0.87$). Organization-level financial performance is measured using the return on sales (O-LNROS), return on assets (O-LNROA), and return on equity (O-LNROE).

Organization-level human management practices. Factor analyses of all management practices suggest that the practices belong to two different groups: the organization-based human resource management system (O-HRM), and the project team management system (P-HRM). The overall reliability score for (O-HRM) is ($\alpha = 0.81$), consisting of: (1) selection based on ability to work on team and the willingness to cooperate; (2) The reward structure in this system

consists of the extent to which cooperative behaviors have any impact on individual salary increase, award of bonus payment, promotion, and job assignment; (3) Control over individuals' rewards is measured by how much control the project manager, human resource manager, and peers have on individual salary increase, promotion, and job assignment; (4) Cross-functional orientation is measured by whether companies put new professional employees through cross-functional orientation at both the operational and corporate levels; (5) Work pattern is measured by whether daily task requires the use of team, and by the level of participation of employees on cross-functional teams (i.e., quality circles). (6) Cross-functional training and development were determined by whether companies put their engineers through on and off-the-job training and job rotation in other functions, particularly R&D, sales/marketing, and manufacturing.

The project team-level human resource management practices. The project team-level human resource management system (P-HRM) ($\alpha = 0.60$) is composed of: project team training (training provided for performing tasks on a particular project); reward (team performance affects salary increase, bonus, job assignment, and promotion); and project team membership selection (selection based on cross-functional job experience, knowledge, and expertise for project). The lower reliability score for the project-team level human resource management system is consistent with the qualitative data, which suggest that although team-based incentive and other practices are institutionalized in the production organization for performing daily tasks (Ichniowski et al., 1997), these practices are not institutionalized for the white-collar workforce. In some cases, the reward is in the form of a favorable job assignment and promotion, while in others it is in the form of bonus and salary increase.

The second-order factors are used to form these systems in order to give each set of practices a more equal weight. If individual measures are used directly, each of the management

practices, (i.e., project team reward (P-RWRD)) which consist of several measures, will have greater weight than say, P-DEVLOP, which only has one measure. Therefore, by combining measures under each practice, (i.e., selection, reward, training, and development), the weights are more evenly distributed for the purpose of conducting the cluster analysis.

Method of Analysis

Since the main goal of this large sample analysis is to confirm the existence and understand the differences among the strategies that firms use to develop the capability to mobilize knowledge and create new knowledge for innovation, and to gauge the effectiveness of each strategy, I perform two types of analyses: First, a cluster analysis to confirm the existence of the three strategies, and, then, a comparison of means to test the differences among strategies in their practices and performance. Once the clusters that define the strategies have been identified, I conduct comparison of means of independent and dependent variables (using both the T-tests and Tamhane's T2 multiple comparison methods), without assuming equal variance, in order to determine which strategy is more effective at developing the capability to mobilize knowledge and create new knowledge for innovation. The same procedures are used to determine which strategy is associated with higher financial performance. The T-test allows comparisons to be made between two strategies at a time, while Tamhane's T2 allows simultaneous comparisons of three strategies. The reason for conducting both tests is that while any three strategies might not be significantly different from each other, they could be significantly different from any given two strategies.

RESULTS: EXISTENCE OF THREE STRATEGIES AND DIFFERENCES IN MANAGEMENT PRACTICES AND PERFORMANCE

Three Strategies for Capability Development

Figure 1 shows the results from the cluster analysis. The results show that companies follow one of three strategies: the organization, project team, and mixed. The three cluster strategies are selected because they have high face validity and the distances between clusters are about equal. The only significant differences between firms are in their organization-based human resource management system (O-HRM), which deals with developing employees at the organization level, and their project team management system (P-HRM), which deals with developing personnel at the project team level. This result is important, as previous studies tend to discuss only the organization-based human resource management and project team human resource management practices as facilitators of the capability to mobilize knowledge and create new knowledge for innovation. The differences in the O-HRM and P-HRM used by companies determine the differences in strategies used to develop the capability to mobilize knowledge and create new knowledge for innovation.

Insert Figure 1 about here

Strategies for Capability Development and Management Practices

Table 1 presents the results of comparison of means of firms' human resource management systems in the three clusters. The results show that companies follow one of three different strategies in developing the capability to mobilize knowledge and create new knowledge for innovation. The three strategies are referred to as: (1) organization strategy,

whereby employees are developed at the organization level regardless of when they will be used in the process of innovation; (2) The project team strategy, whereby employees are developed only as needed when employees are organized into project teams for innovation; (3) The mixed strategy, whereby personnel are developed both at the organization and at the project team level. Choice of strategies is not constrained by industry or country of origin of companies.

The mixed strategy. Cluster 1 consists of 16 companies. Of the 16 companies, four are Japanese and 12 are American. Ten of the companies are in the computer industry, two are in the photo imaging industry, and four are in the automobile industry. These companies are designated as those, which follow the mixed strategy. Companies in this cluster have a higher mean for the organization-level human resource management system (O-HRM) than firms that follow the project team strategy, but a lower mean than firms that follow the organization strategy. Additionally, firms that follow the mixed strategy have a lower mean for their project team-level human resource management system (P-HRM) than firms that follow the project team strategy; but these firms have a higher mean compared to firms that follow the organization strategy.

The organization strategy. Cluster 2 contains five companies that are described as following the organization strategy in developing the capability to mobilize knowledge and create new knowledge for innovation. Of the five companies, two are Japanese and the other three are American. Three are in the computer industry, one is in the photo imaging industry, and one is in the automobile industry. Compared to firms following the other two strategies, these companies use more of the organization-level human resource management system (O-HRM) and the least of project team-level human resource management system (P-HRM).

The project team strategy. Cluster 3 contains 17 firms. Of the 17 firms that follow this strategy, four are Japanese and 13 are American. Seven companies are in to the computer industry, three are in the photo imaging, and six are in the automobile industry. This group of firms is described as following the project team strategy, as they do not focus on developing their employees at the organization level, but only as needed when organizing employees into project teams for innovation. Their mean for project team-level human resource management system (P-HRM) is highest compared to firms that follow the organization strategy and firms that follow the mixed strategy. The mean for their organization-level human resource management system (O-HRM) is the lowest compared to for firms that follow the organization strategy, and firms that follow the mixed strategy.

Insert Table 1 about here

Table 1 also shows the specific characteristics of the three strategies for developing the capability to mobilize knowledge and create new knowledge for innovation, and the factors that differentiate them. The practices that differentiate all three strategies are: project managers' control over individuals' rewards (O-XCNTRL), organization-level cross-functional development (O-DEVLOP), and team-level development (P-DEVLOP), which suggest that companies that follow the mixed strategy use practices that not only the literature suggests as facilitating knowledge mobilization but also creation for innovation. Moreover, when organized for innovation, teams are developed specifically for performing that task.

Two-way comparisons of the three strategies suggest differences at the level of individual practices. There are several specific practices that differentiate firms following the mixed and the organization strategies. Firms that follow the organization strategy, on average, give

significantly more control over individuals' rewards to project managers than do firms that follow the mixed strategy (mean of 4.00 vs. 2.66). At the project level, however, firms that follow the mixed strategy provide a significantly higher level of development and reward to their project teams than do firms that follow the organization strategy (mean of 3.00 vs. 2.00 for P-DEVLOP and mean of 2.67 vs. 1.00 for P-RWRD).

Moreover, firms that follow the mixed strategy differ from firms that follow the project team strategy in the following ways. First, firms that follow the mixed strategy give project managers more control over individuals' rewards than do firms that follow the project team strategy (mean of 2.66 vs. 1.66). Second, unlike firms that follow the project team strategy, at the organization-level, they provide cross-functional development to their engineers through job rotation between R&D and manufacturing, and through off-the-job training in sales/marketing, regardless of when they are organized into teams for creating new knowledge for innovation (2.71 vs. 0.83). Third, they also provide additional development and reward to their employees when organized into project teams for mobilizing and creating new knowledge for innovation, but at a lower level than the firms that follow the project team strategy (mean of 3.00 vs. 4.38 for P-DEVLOP and 2.67 vs. 4.00 for P-RWRD).

There are greater differences in this comparison, of firms that follow the organization strategy and firms that follow the project team strategy, than there are in the previous comparisons with firms that follow the mixed strategy. In comparison with firms that follow the project team strategy, firms that follow the organization strategy put significantly higher emphasis on selecting employees based on behavioral factors conducive to knowledge mobilization (mean of 2.00 vs. 0.83), and give more control to project managers over individuals' rewards (mean of 4.00 vs. 1.66). In addition, they provide cross-functional

development to professional employees (mean of 3.27 vs. 0.83), which facilitates the acquisition of overlapping knowledge, which supports knowledge creation, regardless of when employees are organized to mobilize knowledge and create new knowledge for innovation. However, they do much less than firms that follow the project team strategy at the project level when they organize employees into project teams for innovation (mean for P-DEVLOP is 2.00 vs. 4.38 and for P-RWRD 1.00 vs. 4.00).

Strategies for Capability Development and Performance

Table 2 presents the results from testing the effectiveness of the strategies to develop the capability to mobilize knowledge and create new knowledge for innovation. The significant differences among the three strategies exist in the following outcomes of capability: Overall organization-level product innovation (O-PRODNOV), customer satisfaction with the innovation (O-CUSTSAT), return on sale (LNROS), product innovation at the project level (P-PRODNOV), efficiency at the project level (P-EFFIC), and speed-to-market of the innovation (P-SPEED). For the overall product innovation of the company (O-PRODNOV), the organization strategy seems to be most effective followed by the mixed and the project team strategies. For overall customer satisfaction with the company's innovation (O-CUSTSAT), for product innovation at the project level (P-PRODNOV), and efficiency at the project level (P-EFFIC), the mixed strategy seems to be most effective, followed by the project team and the organization strategies. For speed-to-market of the innovation (P-SPEED), the project team strategy appears to be most effective, followed by the mixed and the organization strategies. However, for financial performance in terms of return on sale (LNROS), we also see that the mixed strategy is most effective, followed by the project team and organization strategies.

When we compare companies that follow the mixed and project team strategies, we see that the mixed strategy is more effective than the project team strategy on the following outcomes: Overall company product innovation (O-PRODNOV), customer satisfaction with the company's innovation (O-CUSTSAT), product innovation at the project level (P-PRODNOV), process innovation (P-PROCESS), and, potentially, efficiency at the project level (P-EFFIC). The project team strategy seems to be more effective for learning (P-LEARN). With other outcomes of capability, the different strategies do not yield significant differences. For financial performance in terms of return on sale (LNROS), return on assets (LNROA), and return on equity (LNROE), the mixed strategy seems to be more effective than the project team strategy.

When we compare the effectiveness of the mixed and organization strategies, we see that the mixed strategy is associated with higher performance on the following outcomes of capability: overall customer satisfaction with the company's innovation (O-CUSTSAT), project level product innovation (P-PRODNOV), efficiency (P-EFFIC), and speed-to-market of the innovation (P-SPEED). Moreover, for financial performance in terms of return on sale (LNROS), we also see that the mixed strategy is associated with higher performance than the organization strategy. However, for return on equity (LNROE), the organization strategy is associated with potentially higher performance.

When we compare the performance of the project team and the organization strategies, we see that the project team strategy is more effective for the following outcomes of capability: overall customer satisfaction with the company's innovation (O-CUSTSAT), project level product innovation (P-PRODNOV), speed-to-market of the innovation (P-SPEED), and learning (P-LEARN). Moreover, for financial performance, we see that the project team strategy is associated with higher performance in terms of return on sale (LNROS). However, the

organization strategy is associated with higher performance than the project team strategy on the following outcomes: overall company-level product innovation (O-PRODNOV) and potentially process innovation at the project level (P-PROCESS). In terms of financial performance, we see that for return on assets (LNROA) and return on equity (LNROE), the organization strategy is associated with higher performance. I also tested for the effect of industry and country of origin of companies and found no significant effects on these strategies and outcomes, although certain industries and companies with different national origins tend to put more emphasis on certain practices than others.

Insert Table 2 about here

In summary, the mixed strategy, whereby employees are developed both at the organization and project team levels when organize for creating new resources for the firm, (i.e., innovation), seems to be the most effective for overall customer satisfaction with company products, and for product innovation and efficiency at the project level. Moreover, companies that follow this strategy also seem to have higher level of financial performance. However, for speed-to-market of the innovation, the project team strategy seems to be more effective than the mixed strategy. For other outcomes of the capability, any of the strategies may lead to similar results.

DISCUSSION AND CONCLUSION

As more attention is given to the firm's resources and capability set as a more promising source of competitive advantage, we find it more important to understand how companies develop the capability to mobilize knowledge and create new knowledge for innovation.

Previous studies on innovation that focus on the organization-level factors suggest that firms develop this capability by following the organization strategy (Galbraith, 1977; Lawrence and Lorsch, 1967; Nohria and Ghoshal, 1997). They accomplish this by managing their employees such that the supporting organization-level processes, particularly cross-functional communication and cross-functional cooperation are built into the organization, regardless of when they are needed in the process of innovation. Other studies on innovation that focus on the project team-level factors (Ancona and Caldwell, 1992; Clark and Wheelwright, 1992) suggest that firms develop this capability by following the project team strategy, whereby employees are developed only as needed when personnel are organized into project teams for innovation. As the literature stands, each stream of literature has distinct implications for the study of organizations and strategic management.

This study develops the resource-based theory of the firm and bridges the gap between the two streams of literature by showing that companies follow one of three distinct strategies in developing the same capability. In addition to the organization and project team strategies suggested by previous research, companies also follow the mixed strategy. Instead of developing their employees at either level, in a way that facilitators of knowledge mobilization such as cross-functional communication and cooperation are embedded in their daily context, or developing them as needed when personnel are organized for innovation, many companies do a little of both. In particular, the mixed strategy involves developing their human resources so that not only facilitators of knowledge mobilization are embedded in the organization, but that the facilitator of knowledge creation or overlapping knowledge (Madhaven and Grover, 1998; Nonaka, 1994), are also available at the organization level. Moreover, when personnel are

organized into project teams for innovation, companies also provide some development on how teams work together to accomplish the task (Beer and Eisenstat, 1996).

This study shows that the mixed strategy is associated with a wider range of outcomes of this capability and better financial performance than the other two strategies. In particular, it supports the overall customer satisfaction with company's products, product innovation at the project level, and efficiency in terms of resources used in achieving the innovation. The main reason is that the capability to create new resources for firms, i.e., innovation that satisfies the demands of external customers, requires both knowledge mobilization of customer preferences, and design and production (Dougherty, 1992), and the factor that facilitates the conversion and transformation of these knowledge sets (Leonard-Barton, 1995; Nonaka, 1994; Madhaven and Grover, 1998). This facilitator is the absorptive capacity (Cohen and Levinthal, 1990) for different knowledge being shared. Since this overlapping knowledge is acquired through cross-functional development, the critical organization-level factor is this practice. Further, since different innovation projects require different individuals with different knowledge sets (Iansiti, 1998), even if there is overlapping knowledge available at the organization level, additional development, whereby team leaders or corporate trainers facilitate the organization of the work processes of project teams, seems to be most effective.

The different strategies that companies use to develop the capability to mobilize knowledge and create new resources are not explained by the industries in which they compete. This result suggests that companies have the strategic choice to choose the strategy they want to use to develop this capability (Miles and Snow, 1978), although companies in certain industries tend to emphasize certain practices more than companies in other industries (Lawrence and Lorsch, 1967).

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FIGURE AND TABLES

FIGURE 1

Hierarchical cluster analysis of human resource and project team management systems:

Cluster 1 mixed, Cluster 2 organization, Cluster 3 project team

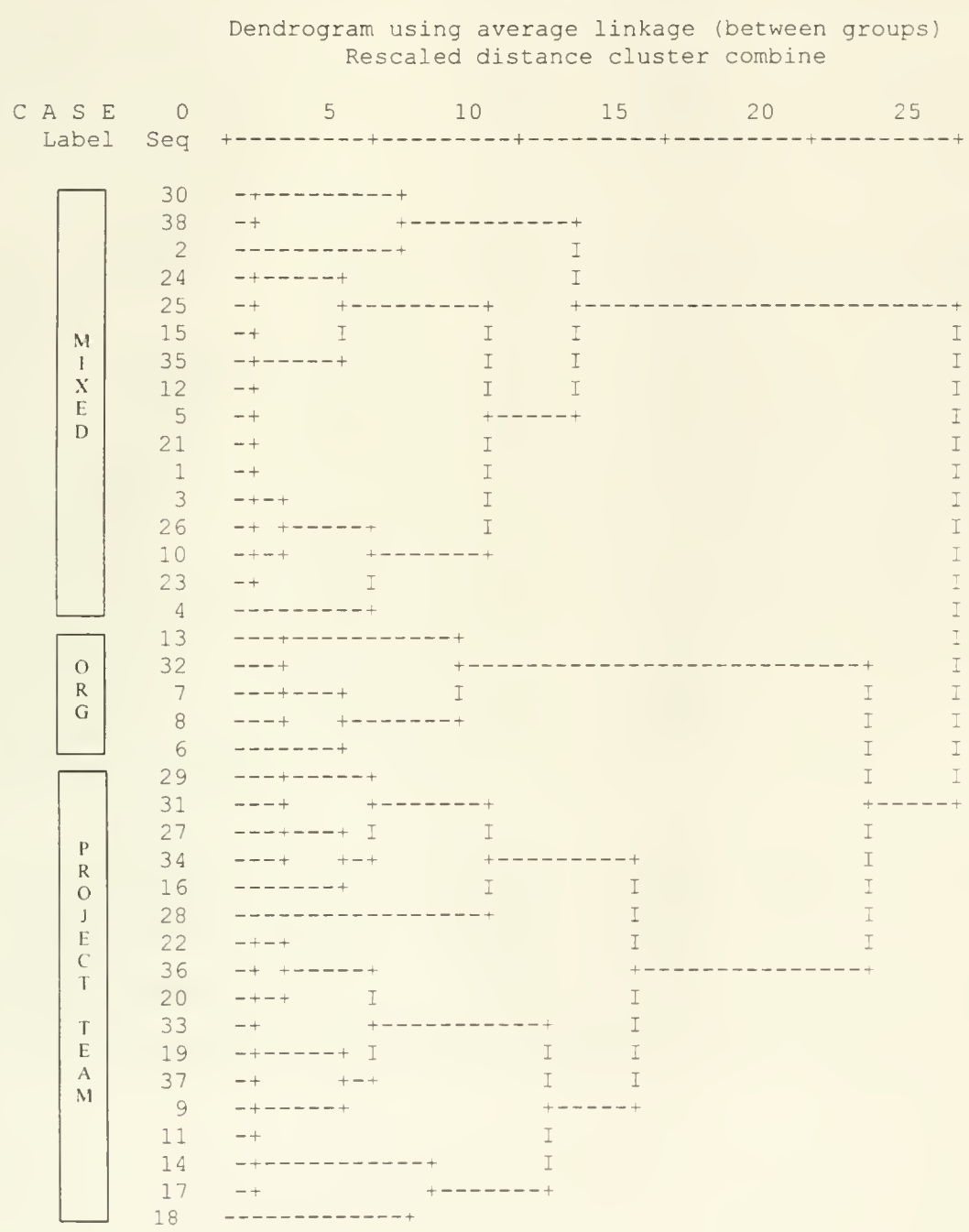

TABLE 1

Human resource management systems and practices of the three strategies: Cluster 1 mixed strategy, Cluster 2 organization strategy, and Cluster 3 project team strategy

Clustering variables	Cluster 1 Mixed (N=16)	Cluster 2 Organization (N=5)	Cluster 3 Project team (N=17)	T-tests			Tamhane's T2
				1 vs. 2	1 vs. 3	2 vs. 3	1 vs. 2 vs. 3
Organization-level human resource management system (O-HRM)	3.42 (0.94)	4.33 (0.91)	0.83 (0.99)	*	***	*	*
Project team-level human resource management system (P-HRM)	2.31 (1.16)	0.66 (0.91)	3.54 (0.49)	**	***	***	*
Organization-level human resource management practices (O-HRM)							
Select team-based behaviors (SELECT)	2.33 (2.28)	2.00 (2.73)	0.83 (1.91)		**	**	
Reward behavioral factors (RWRD)	3.00 (2.58)	3.05 (2.73)	2.44 (2.50)				
Control of project manager (O-XCNTRL)	2.66 (2.73)	4.00 (2.23)	1.66 (2.42)	*	*	*	*
Cross-functional orientation (ORIEN)	0.42 (0.36)	0.50 (0.32)	0.44 (0.31)				
Cross-functional work pattern (WKPTRN)	2.96 (2.58)	4.00 (2.23)	3.05 (2.50)	*		*	
Cross-functional development (DEVLOP)	2.71 (1.75)	3.27 (2.23)	0.83 (0.38)		*	***	*
Project team-level human resource management practices (P-HRM)							
Project team training (P-DEVLOP)	3.00 (2.53)	2.00 (2.73)	4.38 (2.13)	***		**	*
Project team reward (P-RWRD)	2.67 (2.88)	1.00 (1.55)	4.00 (2.23)	*	*	*	
Project team selection (P-SELECT)	3.66 (2.44)	3.10 (2.23)	3.44 (2.50)				

Note: means, standard deviation in parentheses. Significance: *** 0.001, ** 0.01, * 0.05, † 0.1.

TABLE 2

Outcomes of the capability to mobilize knowledge and create new knowledge for innovation and the three strategies: Cluster 1 mixed strategy, Cluster 2 organization strategy, and Cluster 3 project team strategy

Performance	Cluster 1 Mixed (N=16)	Cluster 2 Organization (N=5)	Cluster 3 Project team (N=17)	T-Test			Tamhane's T2
				1 vs. 2	1 vs. 3	2 vs. 3	1 vs. 2 vs. 3
Organization-level							
Product innovation (O-PRODNOV)	0.79 (0.47)	0.83 (0.57)	0.27 (0.57)		**	*	*
Customer Satisfaction (O-CUSTSAT)	1.32 (0.28)	0.08 (1.51)	0.87 (1.33)	*	*	*	*
O-LNROS	1.34 (0.98)	0.08 (1.51)	0.87 (1.33)	**	*	*	*
O-LNROA	0.77 (1.31)	0.99 (1.52)	0.29 (1.91)		*	*	†
O-LNROE	1.09 (1.68)	1.31 (1.63)	0.29 (1.91)	†	*	*	†
Project team-level							
Product innovation (P-PRODNOV)	3.92 (0.53)	2.75 (0.35)	3.61 (0.65)	*	*	*	*
Process innovation (P-PROCESS)	3.67 (1.25)	3.46 (1.47)	3.25 (1.51)		*	†	
Efficiency (P-EFFIC)	1.92 (0.27)	1.50 (0.70)	1.67 (0.39)	*	†		*
Speed-to-market (P-SPEED)	3.28 (0.56)	3.00 (0.10)	3.29 (0.35)	*		*	*
Customer satisfaction (P-CUSTSAT)	3.23 (1.21)	3.42 (1.41)	3.25 (1.61)				
Learning (P-LEARN)	3.87 (1.23)	3.67 (1.18)	3.94 (0.63)		†	*	

Note: means, standard deviation in parentheses. Significance: *** 0.001, ** 0.01, * 0.05, † 0.1.

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